

Notice of Allowability

Application No.

10/714,115

Applicant(s)

FISHBURN ET AL.

Examiner

Shouxiang Hu

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 09-13-04 Amendment.
2. ☒ The allowed claim(s) is/are 17-36.
3. ☐ The drawings filed on _____ are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

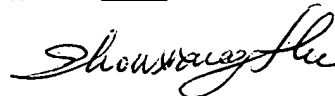
* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☒ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
- (b) ☒ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date 20041207.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date 11/13/03
4. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413),
Paper No./Mail Date 20041207
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____



SHOUXIANG HU
PRIMARY EXAMINER

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Katherine Hamer (RN: 47,628) on December 7, 2004

The application has been amended as follows:

IN THE CLAIMS

1-16. (canceled)

17. (Original) A method of forming a double-sided capacitor having increased capacitance, comprising:
forming a first opening in a first insulating layer on a semiconductor wafer;
forming a first sacrificial liner along sidewalls of the first opening;
forming a sacrificial plug adjacent to the first sacrificial liner, the sacrificial plug formed from a material having a different etch selectivity than a material used in the first sacrificial liner;
forming a second insulating layer over the first insulating layer;
forming a second opening in the second insulating layer, the second opening in substantial alignment with the first opening;

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forming a second sacrificial liner along sidewalls of the second opening;
removing the sacrificial plug;
forming a first conductive layer over the first and second sacrificial liners, the first
conductive layer having a first surface and a second surface, wherein the first
surface of the first conductive layer contacts the first and second sacrificial liners;
selectively removing the first and second sacrificial liners to expose the first surface of
the first conductive layer;
forming a dielectric layer over the first and second surfaces of the first conductive layer;
and
forming a second conductive layer over the dielectric layer.

18. (currently amended) The method of claim 17, wherein forming a the first sacrificial liner along sidewalls of the first opening comprises forming the first sacrificial liner from a material selected from the group consisting of titanium nitride, polysilicon, and hemispherical grain polysilicon.

19. (currently amended) The method of claim 17, wherein forming a the first sacrificial liner along sidewalls of the first opening comprises depositing the first sacrificial liner by chemical vapor deposition.

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20. (currently amended) The method of claim 17, wherein forming a the first sacrificial liner along sidewalls of the first opening comprises forming the first sacrificial liner from titanium nitride.

21. (currently amended) The method of claim 20, wherein forming a the sacrificial plug adjacent to the first sacrificial liner comprises forming the sacrificial plug from polysilicon or hemispherical grain polysilicon.

22. (currently amended) The method of claim 17, wherein forming a the first sacrificial liner along sidewalls of the first opening comprises forming the first sacrificial liner from polysilicon or hemispherical grain polysilicon.

23. (currently amended) The method of claim 22, wherein forming a the sacrificial plug adjacent to the first sacrificial liner comprises forming the sacrificial plug from titanium nitride.

24. (currently amended) The method of claim 17, wherein forming a the second sacrificial liner along sidewalls of the second opening comprises forming the second sacrificial liner from a material selected from the group consisting of titanium nitride, polysilicon, and hemispherical grain polysilicon.

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25. (Original) The method of claim 17, wherein removing the sacrificial plug comprises removing the sacrificial plug without removing the first and second sacrificial liners.

26. (Original) The method of claim 25, wherein removing the sacrificial plug comprises removing the sacrificial plug using a solution of hydrogen peroxide and sulfuric acid or a solution of tetramethylammonium hydroxide.

27. (Original) The method of claim 17, wherein selectively removing the first and second sacrificial liners to expose the first surface of the first conductive layer comprises removing the first and second sacrificial liners using a solution of hydrogen peroxide and sulfuric acid or a solution of tetramethylammonium hydroxide.

28. (Original) The method of claim 17, wherein selectively removing the first and second sacrificial liners to expose the first surface of the first conductive layer comprises removing the first and second sacrificial liners without damaging exposed components on the semiconductor wafer.

29. (Original) The method of claim 17, wherein selectively removing the first and second sacrificial liners to expose the first surface of the first conductive layer comprises removing the first and second sacrificial liners without removing the first conductive layer.

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30. (Original) The method of claim 17, wherein selectively removing the first and second sacrificial liners to expose the first surface of the first conductive layer comprises forming an open space adjacent to the first surface of the first conductive layer.

31. (currently amended) The method of claim 17, wherein forming a the first conductive layer over the first and second sacrificial liners comprises forming the first conductive layer from titanium nitride or polysilicon.

32. (currently amended) The method of claim 17, wherein forming a the dielectric layer over the first and second surfaces of the first conductive layer comprises depositing an insulative material over the first and second surfaces of the first conductive layer.

33. (currently amended) The method of claim 30, further comprising increasing a thickness of the open space by removing at least a portion of each of the insulating layers.

34. (currently amended) The method of claim 33, wherein removing the at least a portion of each of the insulating layers comprises etching the at least a portion of each of the insulating layers using a solution of hydrogen fluoride.

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35. (currently amended) The method of claim 17, wherein forming a the dielectric layer over the first and second surfaces of the first conductive layer comprises depositing an insulative material over the first and second surfaces of the first conductive layer.

36. (currently amended) The method of claim 17, wherein forming ~~a~~ the second conductive layer over the dielectric layer comprises forming a top electrode of the double-sided capacitor.

37-48. (canceled)

Allowable Subject Matter

Claims 17-36 are allowed.

Reasons for Allowance

The following is an examiner's statement of reasons for allowance: Prior art does not teach or render obvious a method of forming a double-sided capacitor as defined in the allowed claims above, comprising particularly the steps of: forming a first sacrificial liner and forming a sacrificial plug of different materials in a first opening in a first insulating layer; forming a second sacrificial liner in a second opening in a second insulating layer; removing the sacrificial plug; and filling the two aligned openings with a first conductive layer that has an external surface in contact with the two sacrificial

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liners; and selectively removing the two sacrificial layers so as to expose the external surface of the first conductive layer.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Drawings

The drawings are objected to because of the following informalities and/or defects:

The top portions (immediately under the top line) in Figs. 3-7 are not marked by any numerals; and they should be removed.

In Figs. 10-12, the lateral dimension for layer 90 appears to be too thin. The lateral scale for layer 110 appears to be inconsistent in Figs. 11 and Figs. 11 and 13.

In Figs. 13 and 20, the recited dielectric layer (130) is not clearly shown or it is too thin in the drawings. Furthermore, the numerals 130 and 132 apparently point to wrong positions in Fig. 20.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure

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is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. References A-E are cited as being related to a method of making a capacitor.

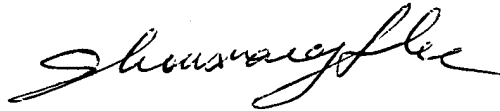
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shouxiang Hu whose telephone number is 571-272-1654. The examiner can normally be reached on Monday through Thursday, 7:30 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SH
December 7, 2004

A handwritten signature in cursive script, appearing to read 'Shouxiang Hu', written in black ink.

SHOUXIANG HU
PRIMARY EXAMINER